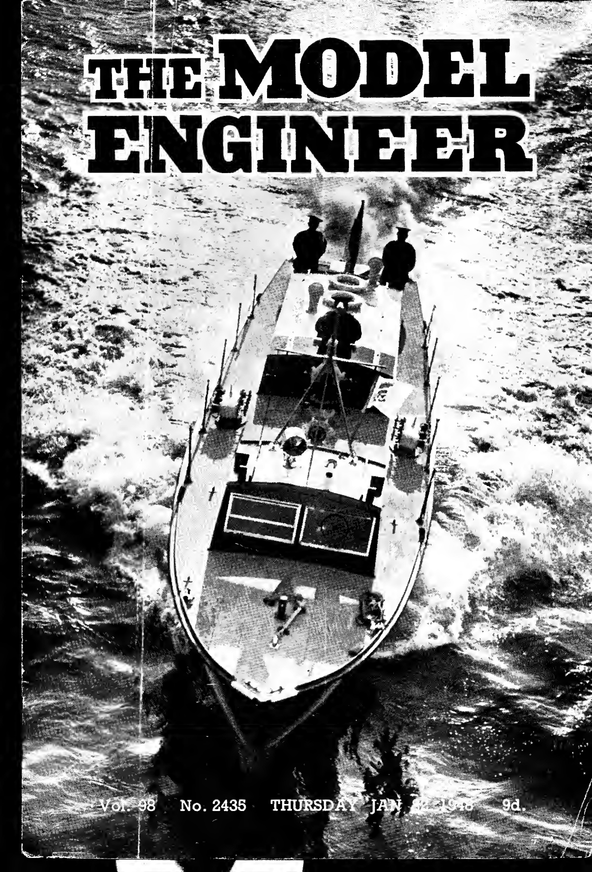
THE MODEL ENGINEER



Vol. 98 No. 2435 THURSDAY JAN 22 1948 9d.

The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

22ND JANUARY 1948 VOL. 98 NO. 2435

SMOKE RINGS

Our Cover Picture

● THIS IS the *James Braidwood*, a 45-ft. launch, built for the N.F.S. by Messrs. J. Samuel Wright of Cowes. It is powered by three 6-cylinder Meadows petrol engines, each developing 110 b.h.p. at 2,700 r.p.m., driving three propellers. This craft has a speed of 20 knots and the three Dennis pumps each have a capacity of 750 gallons per minute at a pressure of 100 lb. per sq. in. She is stationed at Woolwich, at the depot adjacent to the Woolwich free ferry.

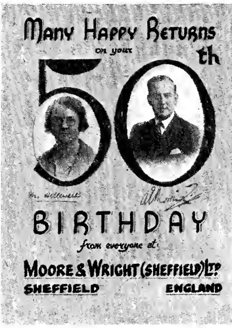
Assembling a Model

● IN READING the description of Mr. J. S. Harwood's fine showman's road locomotive in our issue of January 8th, I was much impressed by his concluding comment on the patience required in assembling a model once all the parts had been made. He said of any model "it almost invariably has to be assembled and dismantled so many times—and no amount of previous planning seems to ease this situation." I imagine many of my readers have discovered the truth of this observation. Preliminary assemblies are necessary to ensure that all the various parts fit exactly into their prescribed positions and that there is no fouling of one moving part with another, or with any part of the main structure. There is also the question of the correct order of assembly so that one part already fixed in place does not obstruct the insertion or fixing of another part. The accessibility of bolts and nuts and screws is another problem, the difficulties of which may not come to light until the assembly is actually put in hand. The designer may have shown a fixing, so easy to insert on the drawing board, but so difficult to negotiate in the solid metal. Some of the assembly problems may be simplified by first assembling a group of parts as a complete unit, and then fixing the whole group in place on the model; but whatever method is adopted there must almost invariably be a period of trial placing of the parts which will determine the best procedure when the final assembly is made. Then comes the time of taking down for painting and applying any finishing touches, and lastly the complete assembly of the perfected model during which the greatest care is necessary to avoid bruising any nuts or screw-heads, or scratching or marking any of the polished or painted surfaces. I have no records at my elbow, but I remember reading of the vast amount of time and patient care expended by some builders of notable exhibition models to ensure that the result should be one of perfection. Indeed, this problem of assembly has sometimes caused more headaches than the fashioning of many of the component parts. It is a matter which often escapes attention in articles describing the construction of models, and I should be interested to have any practical observations and experiences which those who have passed through these anxious moments may care to send me.

PLEASE CUT THIS OUT FOR REFERENCE

A Novel Greetings Card

● A PARTICULARLY pleasing item in my fiftieth anniversary mail was a specially prepared card from Moore & Wright (Sheffield) Ltd., of which I print a reproduction herewith. The sombre tones of black ink do not do justice to the attractiveness of the card with its light blue background and the figures 50 surrounding the portraits in shining gold. The portraits are of especial interest to me, for on the left is Miss Marion Hellewell, a Director, and on the right Mr. A. E. Morrison, the Managing Director, which gives the card the authoritative stamp of the firm's official blessing. Miss Hellewell has for many years past been a popular figure on the firm's stand at the "M.E." Exhibition and has achieved quite a reputation for her profound knowledge of precision tools in all their many forms. Her many friends will, I am sure, join me in congratulations on her recovery from a recent serious illness. Mr. Morrison too is another staunch friend to model engineers, and is worthily carrying on the traditions set by the late Mr. Frank Moore, the founder of the firm and a most charming personality.



Our Anniversary Post-bag

● I HAVE received so many kindly letters on this notable occasion in our history that lack of space will not permit me to use these letters in full. I have, however, made a few extracts of interesting points, and hope all my correspondents will accept my grateful thanks for their very welcome expressions of appreciation. Wilfrid L. Randell writes about his early days in Plymouth and asks if any other readers remember his favourite local steamer *Sir Francis Drake*, then in service as a G.W.R. mail tender. He says "If I was 'lost' on a steamer trip, I hadn't fallen overboard—I was down below in the engine room." Col. H. J. Wellingham of Cable and Wireless Ltd. writes :—"I became a subscriber to THE MODEL ENGINEER in 1910 when I joined Davy Paxman & Co. Ltd. of Colchester in that year, and, with the exception of two wars, I have been a subscriber ever since. I regularly received your paper when I was for six years in the island of Madeira. I would like you to know how very useful the various articles and charts and tips in THE MODEL ENGINEER were to me when I was in charge of mechanical training for the Company." Professor D. A. Wrangham (Sunderland Technical College) writes :—"During thirty years of travel and change I have seen THE MODEL ENGINEER in some queer and unexpected places, but I have always found the reader approachable if, on some occasions, a little retiring. You have done a great and human service and no matter how long and glorious the future of your paper may be, the giants of the past will be remembered with profound respect, admiration, and affection." Mr. H. J. Hincks writes :—"I can never fully appreciate what I owe to the publication and its founder. It has been a constant companion through all the phases of a technical and professional career, and now that I have retired it still makes radiant my life today." Mr. John A. Pickles writes : "After forty-eight years among the mill engines and gearing of Lancashire cotton mills, I am proud to look back and say THE MODEL ENGINEER backed me up more than anything else."

Our Speedboat Competition

● THE ENTRIES for our 1947 speed-boat competition were not very numerous but they present some special points of interest. In the first place, the wide interest aroused by the competition is indicated by the fact that five different clubs were represented—Victoria Park, Guildford, Bourneville, Altrincham, and Orpington. It is also interesting to note that steam and 4-stroke power plants shared the honours between them, and that there appears to be a general revival of interest in flash steam, after several years in which it seemed to be on the decline. No new records were set up, but the speeds achieved were highly creditable in view of the many difficulties with which both builders and clubs were faced during 1947. Briefly stated the results were as follows :—Class A : G. Lines (steam), 42.51 m.p.h., B. Pilliner (steam), 41.06 m.p.h., and K. Williams (4-stroke i.c.), 30.88 m.p.h. Class B : D. Innes (4-stroke i.c.), 35.4 m.p.h., F. Jutton (steam), 31.8 m.p.h., and Class C : A. F. Weaver (4-stroke i.c.), 30.69 m.p.h. A full report of the entries, with particulars of the boats, is being prepared and will appear in a later issue.

Percival Marshall

FACTORY METHODS

in the Home Workshop

by "1121"

WHATEVER may be the state of completeness or incompleteness of the model engineer's workshop, he would do very well to invest in a small fly-press. It would not be at all an expensive proposition, as a second-hand fly-press can frequently be purchased from some engineering works or other. Quite apart from the construction of tools, more or less elaborate, for use in the press, the amateur will be surprised at the frequency with which the machine can be called into use for such odd jobs as pushing bushes into holes, pressing wheels on to axles, flattening small sheet-metal parts, etc., and the press has the great virtue that no power is required for its operation.

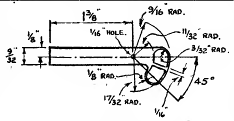


Fig. 1. *A typical subject for blanking and piercing*

A few words on the construction and operation of the press may not be out of place here, for the benefit of any folk who may not have come across this most useful piece of equipment. Briefly, the fly-press is similar to any other press, in that it possesses a bed and a ram, the former for supporting the bottom half of the press tool which is being used, known as the die, and the latter for performing the required operation, by means of some description of punch. The ram is propelled downwards towards the bed by means of a coarse screw thread, rotated by a cross-bar at the top, having a depending handle at one end and a large weight, usually a cast-iron ball, at the other. It will be seen that a good swing of the handle will impart sufficient momentum to the weight to produce considerable pressure at the ram. For lighter work the ball can be removed. A nut, working on a fine screw thread superimposed on the coarse operating thread, can be locked at any height, forming a stop to limit the downward movement of the ram to a predetermined position if required. The bed of the press has T-slots by which the bolster of a press-tool can be held down, and the ram has a hole to receive an adaptor, and some means of clamping it in position. The punch unit of a press-tool is provided with a tapped hole, into which an adaptor can be screwed as desired, or left in permanently.

So much for the press. Let us see how it can be made to earn its living in our home workshop.

The main classes of work normally done on presses are blanking, piercing, bending, drawing and cropping, or combinations of various of these operations. However, we will learn to walk before we try and run, and consider them separately, with a view to their accomplishment in our little press.

Blanking

This is the process of producing a flat sheet-metal part of an outline which may be simple or extremely complicated. It is a process hardly likely to be used to any great extent by the amateur, but we will be clear on its elementary principles while we are about it, in case it may be useful.

The operation is carried out by means of a die having an aperture of exactly the shape and size of the part to be produced. Over this is laid the material from which the part is to be blanked allowing not less than about one-and-a-half times the thickness of the material between the edge of the blank and the edge of the material. The top half of the tool consists of a punch, also of the same shape as the blank, but a little smaller, and it is made to descend on to the material. The pressure is continued, and when the punch has been driven about a third of the way through the material, the metal shears, further downward movement of the punch ejecting the blank from the stock and pushing it into the hole in the die. There, in essence, is your blanking tool, although further complication is necessary before the design can be considered as a workable tool. In the first place, a pair of strips have to be provided at the sides of the die aperture to guide the long strip of stock material through the tool. Some device is necessary, also, to hold down the waste strip while the punch is withdrawn from it on the upward stroke of the press, as the stock clings tightly to the punch. The usual way in which this is achieved, and, incidentally, the simplest and most suitable for amateur construction, is by means of a fixed "stripper," screwed and dowelled to the top of the die, with the two "guide strips" for the stock, one on either side, sandwiched in between. The stripper has through it a hole, the same shape as the hole in the die, and immediately over it, which is a slide fit for the punch. The distance between the underside of the stripper and the top of the die, or in other words the thickness of the guide strips, is not important. From a minimum of about $\frac{1}{8}$ in. for very thin stock, it increases as the thickness of the stock increases, being never less than about twice the thickness of the stock.

This type of stripper performs another useful

service, in guiding the punch into the hole in the die. With a clearance between the two amounting at the most to only a few thousandths of an inch, the accuracy of the press ram is never relied upon. Results would be disastrous to the tool, and possibly to the press itself, should the two members get out of alignment. It may not always be possible to use the stripper as a guide in this way, for a number of reasons which need not concern us here, except to mention that if a power press is being used its stroke may not be capable of adjustment to ensure that the punch does not completely leave the stripper in its upward stroke. Obviously, as much damage could be done should the punch come down on top of the stripper as if it were to hit the die. Where the stripper cannot be used as a guide, for this or any other reason, the punch member is made to slide up and down on substantial pillars fixed in the bottom bolster. This system, although the more frequently used in commercial practice, is a little bit outside our purpose, for the time being at any rate.

Piercing

Piercing is, as its name implies, the operation of producing a hole in a piece of plate. One of its virtues lies in the fact that a hole of practically any shape can be pierced, when its outline may be so intricate that it cannot be produced by any other method. Basically, the method is precisely the same as that used for blanking, in that a punch pushes a piece of metal out of the sheet and into a hole in the die. If piercing is being done on its own, it is probable that the part has already been blanked, or cut to shape by some means, and most likely therefore has some irregular outline which cannot be located by simple strips. In this case it is either located between a number of pins in suitable places round its outline, or is "nested" in a plate or series of plates cut out to receive it—frequently a piece of the very stock from which it was blanked, with the outline trimmed round with a file to enable the blank to be dropped in easily.

The part, of course, has to be stripped from the piercing punch, which may be done by a fixed stripper if the shape of the part is such that the stripper need only cover the locality of the holes, to enable the part to be manipulated into and out of its location. If a fixed stripper is inconvenient, it may be necessary to arrange a sprung stripper sliding down the punch or punches to push the blank off. It is necessary to mention that in blanking, the hole in the die is made to the dimensions of the blank, while the punch is made smaller to clear, while in piercing the punch is made to size and the hole is slightly larger. A little thought will make this point obvious. An approximate clearance for brass and mild-steel may be arrived at by allowing 0.001 in. *all round* per 1/64 in. of thickness of material. Obviously, for a round punch *double* this amount must be allowed on the *diameter*.

Bending

There is no need to describe the process of bending, but the methods by which it is accomplished in a press tool are so varied for different kinds of parts that it is only worth while describing a few of the very simplest forms of bending tools, as every job is different, and the more complex they get the more temperamental they can be. A very slight alteration to the shape of a component may mean not merely an alteration in dimensions but that the whole design of the tool has become entirely unsuitable for the job.

One of the main things which have to be remembered is that a job usually has to be held down while some part of it is bent—knocking down one end, in effect, is bound to cause the other end to kick up in the air, probably out of its location, and bending without location is asking for trouble, due to the tendency of the job to "skid" unevenly on the die and come out bent lop-sided. Another thing which has to be watched is the springiness of the metal: to achieve a right-angle bend it is necessary to bend the plate several degrees farther than required, so that it shall spring back to the right shape. It is impossible to give exact figures, of course, as so much depends on the type of material being used, the radius of the bend, and so on.

It is also inadvisable to try and bend too near a hole, as the hole will be pulled out of shape by the stretching of the metal which takes place. Also there must be *enough* metal to bend. You can't get hold of a lump of next-to-nothing and expect to bend it, as it will just stay flat.

Drawing

This is a process which *could* be of very great value to the modelmaker, consisting, as it does, of bulging out a piece of flat metal into domes, hemispheres, shallow trays, deep boxes, etc., without cutting and rejoining any corners. Unfortunately, however, it is about the most difficult operation for which to design a tool, sometimes involving the most complicated calculations, and even an expert cannot always tell whether a job can be formed up in one operation or whether successive "easy stages" will be necessary. The tools themselves are usually remarkably simple, but the designing of them can be extremely difficult, and for this reason the operation, although, as said before, it could be one of the most useful to the amateur worker, is usually out of his reach.

Cropping

In direct contrast to the above the process known as cropping can be available to any amateur who can make use of it, and it is one of the most useful operations performed by press tools, being particularly suitable for a small shop not desiring to spend a lot of time and money on making more elaborate tools. It consists of shearing off the end of a strip to a predetermined shape, where the contour of the end does not have to be positioned accurately relative to the sides of the strip, and it has the further virtue that one tool can be made adjustable to produce strips of varying lengths, and even a different shape each end. As cropping is so simple and useful, it will be dealt with in detail when the time comes.

Let us now leave generalities, and see how these

various processes can be pressed into use (literally) for our own purposes.

Blanking

To illustrate an application of this operation we can hardly do better than consider again the signal-arm which formed the "guinea-pig" for our early experiments in the realm of the drill jig. Here is a part of which a respectable number might quite easily be required, and which lends itself admirably for our purpose. It has a fairly simple outline (simple, that is, for a press-tool subject) and two nice awkward holes which are normally a headache to the modelmaker. Let us first of all design a blanking-tool for this component. A sketch is shown in Fig. 1, to refresh our memories, this time with a few dimensions added to make it more interesting. Fig. 2 shows the simplest possible blanking tool for this component. Notice the way the punch is secured in the punch-plate, by riveting over the top. For our purpose the punch and die can quite well be made of mild steel, and case-hardened before finally stoning and polishing round the cutting edges. In a factory, of course, all tools are made of tool steel, hardened and tempered, with the possible exception sometimes of bending punches and dies which have no very heavy duties to perform. The "adaptor," which screws into the "adaptor plate" of the tool is shown separately. The diameter of this will have to be made to suit the press—the usual size for a fly-press is 1 in. It must, of course, be screwed tightly into the adaptor plate, and locked with a grub-screw to prevent it moving.

A tool for piercing the three holes is shown in Fig. 3. The shape of the part lends itself to the use of a fixed stripper, still leaving plenty of the job exposed for handling.

This finishes the signal-arm, as far as press-work is concerned, but as a matter of interest let us consider the method by which these blanking and piercing operations would probably be combined in one tool in a machine-shop where quantities justified the making of the more expensive tool. The method is hardly likely to be of use to us in our small shop, but it is interesting, and represents a class of tool for which the tool designer is probably most frequently asked. Fig. 4 shows the tool, and it will be observed that the holes are pierced in the stock *before* the part is blanked out, this obviously being the simplest way of holding the part while it is being pierced. The blanking punch, in the majority of cases, is provided with pilots, which locate in the holes already pierced, ensuring their accurate positioning relative to the outline shape. The signal-arm which we are considering as our component is a little bit touchy in this respect, as the holes are rather close together to be able to rely on them for accurate location. A small angular inaccuracy here, at these short centres, would be magnified over the length of the arm, were the component such as to require a small hole to be pierced up at the other end, and might produce appreciable inaccuracy in the position of this hole. As we have no such hole to worry about, however, and our job is not unduly fussy, we will trust to our two spectacle-holes for our pilot location. (The pivot-hole farther up the

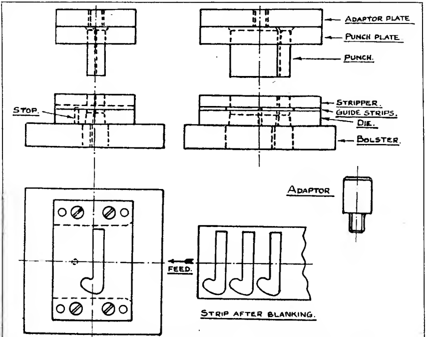


Fig. 2. Blanking tool for the signal-arm. (The "adaptor" is shown separately, and is screwed into the "adaptor plate")

arm is considered too small for piloting purposes.) Note that in this particular case the pilots can be round pins and locate the blank just as well as if they were made the shapes of the holes. In some cases it is necessary to make odd-shaped pilots, but round ones can generally be used if they are put in the right places.

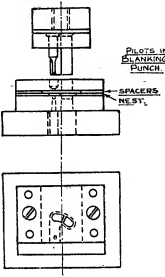


Fig. 3

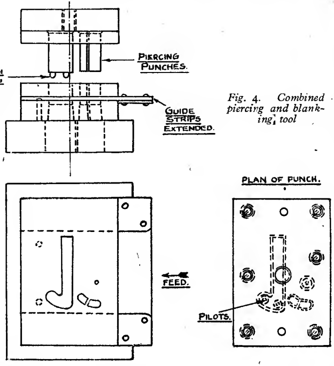


Fig. 4. Combined piercing and blanking tool

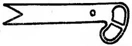


Fig. 5. The "distant" arm

Let us pause for a moment to consider the case we have just mentioned, where the nature of the component might be such that the two holes are considered to be too close together to give a sufficiently accurate location for the blanking punch. Let us make trouble for ourselves by supposing that we are blanking out an arm for a distant-signal, as Fig. 5, and we are using for the sake of argument, a separate notching punch for the fish-tail end, as we think our die might be too flimsy or too difficult to make with the complete form in the blanking operation. Let us stress that the distant-signal arm *could* be blanked out complete, but we are assuming that it couldn't just to illustrate this point. We are going, then, to pierce our notch first, at the same time as we pierce the holes, and then blank the arm "round the notch," if you understand the idea. After all, it might be policy for us to make our tool like this in any case, and remove the notching punch when we want to produce plain square-ended arms : then we would only have to make the one tool, with very little more work, rather than having to make a separate tool for each type of arm. Anyway, we have decided that piloting in our spectacle-holes alone is not good enough, for fear that the notch might come out lop-sided, so what are we going to do about it ? The answer is a separate piercing punch, producing a "service-hole" in the scrap somewhere outside the blank profile, and a separate pilot to locate in it. This is shown in the sketch of the strip, Fig. 6. Luckily our component lends itself, by its peculiar shape, to this treatment : there is plenty of "no man's land" between the blanks for our piloting hole. If there were not, we should have to increase the width of our stock strip on this side and put the hole *outside* the limits of the component. In this case the piloting might be done in a rectangular notch cut into the edge of the strip, rather than a round hole, in order to take up as little extra width of stock as possible. The method, of course, is wasteful of material, and is only resorted to when there no other way out.

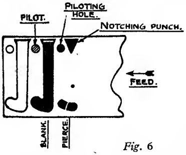


Fig. 6

(To be continued)

Modelling a Hundred Years Ago

by B. Jefferies

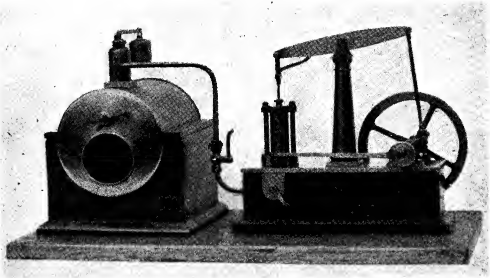
THE appearance, from time to time, in THE MODEL ENGINEER, of descriptions of beam engines, both full-size old veterans and models, prompts me to submit a description of one I have had in my possession for some years.

It was given to me by Mr. William Newth, who, for many years, carried on a business known as the Model Engine Depot, Bordesley, Birmingham. Being interested in model engines, I frequently used to visit his shop, and mutual interest in seeing the wheels go round resulted in a warm friendship between us.

Unfortunately, as a result of the first world war, and the turning of the youthful mind from steam engines to petrol motors, aeroplanes, etc., his business declined, although he had in stock large quantities of engine parts and castings for which there was little demand. His later years found him in poor circumstances indeed, and in 1931, a few months before he died, he asked me if I would take care of the beam engine and Cornish boiler. He told me they were made by the grandfather of a former shopmate of his, a Mr. King, who worked with him many years before, in Cornwall. He said that not having seen him since then, Mr. King called at his shop in Bordesley one day and made himself known to him. He was down and out, and did not know where to turn for a living, but he had the model with him and asked Mr. Newth to take care of it in case anything happened to him. Mr. Newth never saw him again.

I realised that the model was a token of friendship between two shopmates and that by accepting it I ought to care for it as such in memory of my friend Newth and the unknown, but devoted, Mr. King.

Although somewhat "shop-soiled," both engine and boiler were quite undamaged; so a good clean-up and polish rendered them fit to occupy the glass case I made for them. The only parts I added were the setting for boiler, steam-pipe and stop-cock, though the 20th-century model stop-cock looks wrong. A small pulley was fixed on the crankshaft so that, by means of a belt, the movement of the engine can be seen when turning a handle.



An old model Cornish boiler and beam engine

The engine stands on a brass bed-plate, $\frac{1}{8}$-in. thick, resting on a rosewood box-bed. All parts, except beam, piston-rod, connecting and eccentric-rods, are of brass.

The cylinder is $\frac{1}{2}$-in. bore by 1-in. stroke, double-action and reversing. The eccentric operates a four-way cock under the cylinder, and the small lever at the side reverses the exhaust and steam passages.

I was very puzzled at first, for, although when working by compressed air (human breath) there was evidently a downward working stroke, I could find no way by which air could get above the piston until I discovered that the innocent-looking bolt on either side of the cylinder is a tube connecting the upper part with the four-way cock, allowing steam to enter by one bolt and leave by the other.

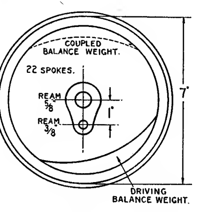
The beam consists of two steel strips neatly joined and, to my way of thinking, looks

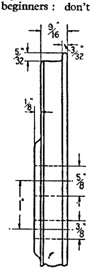
(*Continued on page 90*)

Coupled Wheels for "Maid" and "Minx"

by "L.B.S.C."

THE coupled wheels for the "Maid of Kent" are going to test the stiffness of your lathe, and your skill as a turner; but I hasten to assure beginners that there is nothing to get scared about! I don't suppose there are many readers of these notes who possess a "home-workshop" type and size of lathe, that will carry a three-jaw chuck big enough to take the "Maid's" 7-in. driving and trailing wheels; and if not, the job will have to be done on the faceplate, following practically the same series of operations described when dealing with the machining of "Ada" wheels on an "Adept" lathe. Builders of the "Minx" who have a $4\frac{1}{2}$-in. or a 5-in. three-jaw will be all right, because that size of chuck will take a 5-in. wheel, and the machining operations can be carried out exactly as described for the "Lassie" and other engines. If they have only a small or medium-sized chuck, the faceplate will have to be pressed into service for that job also. There is one difference, however; if the lathe is back-geared, there will be no need to rig up a handle on the end of the mandrel. The slowest normal speed with the back-gear engaged, should suffice for the 7-in. wheels. Too high a speed will take the edge off the best "high-speed" tool ever made; there is a "speed limit" even for tungsten-carbide tipped tools!





Coupled wheels for "Maid of Kent"

The wheel castings should be set up on the faceplate, back outwards, same as if chucked by tread in three-jaw, and the back and flange turned; the boss faced off, and the axle hole drilled and reamed. I shouldn't trust to the truth of even planed hardwood packing for either the 5-in. or 7-in. wheels, but recommend the use of metal packing-blocks, same as I used myself in "$3\frac{1}{2}$-in. Drummond days," when my biggest chuck was 4 in. diameter. To make certain that all three blocks were the same thickness, I sawed them off a piece of $1\frac{1}{4}$-in. by $\frac{1}{4}$-in. steel bar, to the length of about 2 in., and drilled a $\frac{3}{8}$-in. clearing hole in the middle of each. The bolts were pushed through the faceplate slots, and the packing-pieces put over them; the wheel was then placed against the packing-pieces, with the bolts coming between the spokes. A big washer, and a nut, on each bolt, completed the doings. The nuts were screwed up a little more than finger tight, so that the wheel could be set to run true, by tapping it with a "bacon-rind" (rawhide) hammer; after which, the nuts were fully tightened, the back of the rim faced off, the edge of the flange roughed down, and the boss faced, drilled, and reamed.

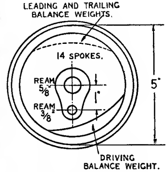
Tips for beginners: don't use a cranked tool for facing, but an ordinary round-nose tool set crosswise in the rest, with as little overhang as possible; otherwise you'll have chatter-marks like the waves on the seashore. The radius of the end of the tool shouldn't be too big; I use a tool that looks like a pointed tool, the point of which has been well rounded off. I find that plenty of top rake, and only sufficient front clearance to allow the tool to cut freely, gives the best result. You can't run too slowly, within reason, when doing the job on a small lathe of 3-in. centres or thereabouts.

Don't trust to your drill, for the truth of the hole through the boss. After facing off, centre and drill right through the boss with a $\frac{3}{16}$-in. drill, or one near that size, using a fairly good speed. Then open out the hole to $\frac{9}{16}$ in. diameter. If you have a drill with a taper shank to fit the hole in the tailstock barrel, you stand a better chance of getting the hole true, than if a straight-shank drill were used in a tailstock chuck. A straight-shank drill can also be put through by holding it against the centre-point of the tailstock barrel, by means of a lathe carrier clamped on the shank; the pilot hole will guide the point, but you'll either have to grip the carrier like nobody's business to prevent it turning, or else run the slide-rest up to it, and let the tail of the carrier run along the top-slide. Watch your step as the drill breaks through! The hole should then be bored out, with a small boring tool in the slide-rest, until the "lead" end of a $\frac{5}{8}$-in. parallel reamer will just enter. The reamer can then be run through as described above for a "floating" drill, putting a carrier on the shank, and feeding it through the hole by means of the tailstock wheel, meanwhile holding the reamer

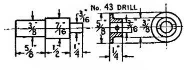
tightly against the tailstock centre, with the point of same in the centre-hole in the end of the reamer.

I might mention here, that I have received umpteen letters from first-timers begging me not to refer back to previous descriptions where it can be avoided, as they haven't the back numbers, so I'll have to compromise somehow, to avoid a lot of repetition !

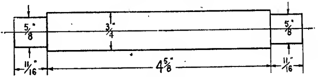
The back of the rim and the boss must be faced flush ; so, after the centre hole has been bored and reamed, take a finishing skim off the back of the rim ; then stop the lathe, and without moving the top-slide, feed the tool past the the same size, if the engine is to run sweetly, regrind the tool, mount each wheel on the peg, don't tighten the clamp bolts enough to spring the wheel, and take a finishing skim off the tread without moving the cross-slide handle. That will do the trick without any measuring whatever. The edges of the flanges can be rounded off by applying a file to them, judiciously, whilst the lathe is running. Warning to beginners : leave the treads "tool-finish," and on no account attempt to polish them up, as I have seen done on engines shown at exhibitions. If the lathe is at all flimsy, or the bearings not properly adjusted, it is a difficult job to avoid chatter-marks



Coupled wheels for "Minx"



Coupling-rod crankpins



Straight axle

fixing bolts ; then start up again and face the boss with the same setting. "Ditto repeato" on all the coupled wheels.

Next item is to turn the treads, and face the fronts of rims and bosses. For this operation, the wheel must run dead true ; so turn a bit of steel a little over $\frac{5}{8}$ in. diameter, to fit the tapered hole in the lathe mandrel, same as illustrated for doing the job on the little "Adept" lathe. When in position, this should project beyond the faceplate for about $\frac{7}{8}$ in., if you are using $\frac{1}{4}$-in. packing-pieces. When the wheel is placed on it, with the packing-pieces between wheel and faceplate, the peg should not stand out clear of the wheel, otherwise you won't be able to face off the boss. Put the peg in the mandrel, and carefully turn it until the wheels just slide on without shake ; then mount each on it, with the packing-pieces *as near the edge of the flange as possible*, just enough clearance being left to allow the flange to be finished off. Tighten the clamp bolts, first face the boss, then the front of the rim, finally turning the treads to a weeny shade over the finished diameter. The treads should be turned with a tool having a slightly wider radius than the facing tool, as the radius between tread and root of flange must not be too small, otherwise the flange will grind against the rail-heads all the time. Don't forget to chamfer the edge of the tread. If a parting-tool is put cross-wise in the rest, a shallow groove can be formed at the point where the spokes join the rim, representing the joint between wheel centre and tyre on a full-sized engine.

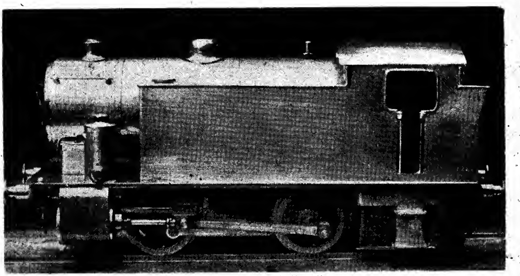
Finally, as coupled wheels must be *exactly* on wheel treads of fairly large diameter, but you don't have to worry. They will soon disappear when the engine starts "earning its living" !

Straight Axles

If the lathe is big enough, the straight axles may be turned from $\frac{3}{4}$-in. steel rod, held in the three-jaw whilst the wheel seats are being turned with a knife tool. On a small lathe, the best plan is to turn the axles between centres, from a piece of round mild-steel, the nearest size larger to finished diameter, that you may have available. A piece of steel a little over 6 in. long, is sawn off, and chucked in three-jaw. It doesn't matter about a big overhang in a small chuck, for centring. Centre with a Slocomb or similar centre-drill in the tailstock chuck ; then put the piece between centres, and reduce the ends in the usual way, using plenty of cutting-oil to get a good seating. The axles should be a tight press-fit in the wheel bosses. Now from time to time, I get letters from friends and relations of Inspector Meticulous, saying that my instructions to turn the seat until it just won't enter the boss, and then ease it with a file, are all wrong. Of course they are, and that is why it usually does the trick ! However, there is an alternative way which can be used by anybody who has either a "mike" or a graduated collar on the cross-slide screw. Chuck an odd bit of steel, any size over $\frac{5}{8}$ in., in the three-jaw, and turn it, by trial and error, to a tight push-fit in the wheel. If you have a "mike," take the measurement of it across the diameter, and turn your wheel seats on the axles half-a-thousandth of an inch larger, which will

give you a press-fit that won't split the wheel boss. If you have a graduated collar on the cross-slide, set it in to a quarter-division less that the setting to which the bit of steel was turned. That will give you the same result. If you haven't either, try this; turn about ¼ in. of the odd bit of steel as above to a tight push-fit, then turn another ¼ in. the weeniest bit larger, so that it just can't be pushed in by hand. Remove from chuck, and see if it will press into the wheel boss by aid of the bench vice, without needing enough "Sunny Jim" to split it. If O.K. press it out between. Turn a bit of round steel about 1 in. long, to a size that will just slide in the hole in the wheel boss; that is, ⅜ in. bare. Open out the larger hole in the bar, with the "lead" end of your parallel reamer, until the peg will just squeeze in to the full depth of the bar. That completes the jig.

To use it, scribe a line down the centre of each wheel-boss, cutting across the middle of the axle-hole. Put the peg of the jig in the axle-hole, and "sight" through the smaller hole, the line scribed on the boss. When it cuts across the centre of the smaller hole, clamp the jig temporarily to the wheel with a toolmaker's cramp, then drill a 23/64-in. hole through the wheel boss, using the one in the jig as a guide; this must also be done by drilling-machine or lathe, as it is essential that the holes go through dead square. Finally, ream the holes in the wheels with a ⅜-in. parallel reamer.



Mr. Parker's "Juliette"

again, and use as a guide for the wheel seats on the axles, transferring the measurements with an ordinary pair of calipers, and judging by the "feel." You can also check off the position of the handle on the cross-slide, or fix a temporary stop on it. It doesn't matter which way you go from London Bridge to Timbuctoo, as long as you get there!

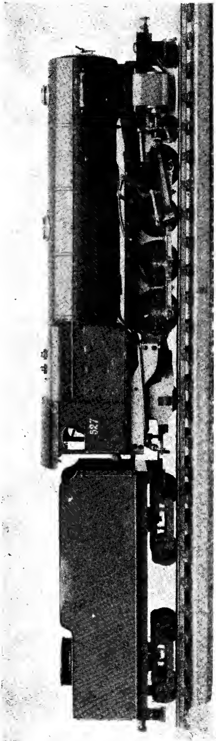
After changing the axle end-for-end, to turn the second wheel seat, the middle part can be reduced to size with a round-nose tool, and that is a kiddy's practice job needing no detailing. Square off the ends in the chuck; the overhang won't matter if you take light cuts.

Crankpins

The coupled wheels must next be drilled for crankpins, and the holes are located by use of a simple jig. For beginners' benefit, this is merely a bit of steel bar, about 1 in. by ¼ in., and say 2 in. long. Scribe a line down the middle, and on it make two centre-pops 1 in. apart; drill them ⅛ in. or No. 30. Open out to 23/64 in. and the other to 39/64 in. These holes must be drilled either on a drilling-machine, or in the lathe, with the drill in three-jaw and the bit of bar held against a drilling-pad on the tailstock barrel with a truly-faced bit of hardwood

The best material for the crankpins would be $\frac{7}{16}$-in. round silver-steel. Chuck a length of this truly in the three-jaw (if your chuck is "out," a piece of foil, or even paper, between the offending jaw and the work, will usually put matters right) and turn ⅜ in. of the end to a press-fit in the wheel-boss, same as described for the axles. Part-off at 1⅜ in. from the end, and repeat the operation for four or six pins as required. Before turning the other ends, make the collars. Chuck a piece of ⅝-in. diameter round mild-steel in the three-jaw; face, centre and drill $\frac{3}{16}$ in. for about 1 in. depth. Turn down $\frac{3}{16}$ in. of the outside to ½ in. diameter, and part off at ¼ in. from the end, repeating operations four or six times as needed. Scrape off any burr around the holes; then chuck one of the crankpins by the turned end, and reduce the other end for ¼ in. length until one of the stepped collars will push on tightly. "Ditto repeato" until

T. M. Parker's "O" gauge Pacific



An "O" gauge "load-shifter," by T. M. Parker

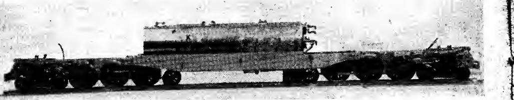
you have done the lot; then push them all on, and drill No. 43 cross-holes through each one, as shown, in the smaller diameter of the collar right through the pin. When the coupling-rods are erected, a pin through the cross-hole will keep the collar in place, as in full-size practice.

The pins can then be pressed home in the wheel-bosses, and one wheel pressed on each axle. Leave the quartering until the crank-axle is done, then the whole lot can be finished off at one go.

Four Fine "Watchmaking Jobs"

Now, going from one extreme to the other, here are some pictures of the handiwork of a follower of these notes, Mr. T. M. Parker, of Nelson, Lancs., who loves "watchmaking" a jolly sight more than Curly does—and he's a "proper dab hand" at the job, as you'll doubtless agree after looking at the samples illustrated. The "Pacific" engine has bar-frames, both main and bogie, and all wheels are sprung, bogie having proper equalisers. The driving wheels are $1\frac{13}{16}$ in. diameter. Cylinders $\frac{7}{16}$ in. bore $\frac{11}{16}$ in. stroke, $\frac{3}{16}$ in. piston-valves operated by Baker valve-gear, and oiled by a mechanical lubricator. The boiler is coal-fired and has a combustion-chamber.

The 4-8-2 is similar, but has $\frac{1}{2}$-in. by $\frac{5}{8}$-in. cylinders, and driving wheels 1 7/32 in. diameter. The "Juliette" has cylinders $\frac{3}{8}$ in. bore by $\frac{1}{2}$ in. stroke, loose-eccentric valve-gear, driving wheels 1 3/32 in. diameter, and a water-tube boiler. This engine will run over one-third of a mile on one filling of the boiler. The side tanks hold water, which is fed to the boiler by a hand-pump.



Mr. Parker's "last word" in gauge "O"

The "Garratt" should be about the last word in "O"-gauge "live steamers." It has six cylinders $\frac{7}{16}$ in. bore and $\frac{11}{16}$ in. stroke, with loose-eccentric valve-gear. The coupled wheels are $1\frac{11}{16}$ in. diameter, all sprung. The boiler is coal-fired, the barrel being $2\frac{3}{8}$ in. diameter, with six 11/32-in. tubes and two $\frac{1}{2}$-in. superheater flues. The total length of the engine is 2 ft. $6\frac{1}{2}$ in. which is some length for gauge "O"! Steam and exhaust-pipes have ball joints. Since the photograph was taken, the engine has been through her steam trials; Mr. Parker says she performs O.K. and the power is marvellous for the size of the engine. Well, I reckon six cylinders of the size mentioned, with six-coupled engine units, ought to have a decent kick, and our worthy "watchmaking" friend certainly deserves hearty commendation for his clever craftsmanship. Honestly, I'd shy at tackling a job like a gauge "O" "Garratt"!

Modelling a Hundred Years Ago

(Continued from page 85)

insignificant, though true to type of beam engines formerly in use in the Black Country. The parallel motion is a very neat bit of work, although it, too, hides its importance in a beam engine in almost unnoticeable proportions. The connecting-rod is nicely shaped and, apparently, balances in its lightness the weight of piston and piston-rod. The engine works perfectly in either direction, by air or steam.

The boiler is of brass tube with ends and flue-tube silver-soldered in. I do not know how the builder intended steam to be raised, whether as a "pot" boiler by spirit-lamp, or by some use of the flue-tube. The safety-valve is well made and finished and looks like the real thing of the old days.

The water-gauge in ingenious. The pointer indicates on a scale, hardly visible in the photograph, the level of water in the boiler. It consists, really, of a plug-tap with an inner tube which turns as the indicator is turned. Should the open end of the inner tube be under water, water issues from outlet pipe. When turned clockwise, as soon as inner tube leaves the water, steam issues from outlet pipe, thus indicating the position of the surface of the water. When shut off entirely, neither steam nor water is emitted.

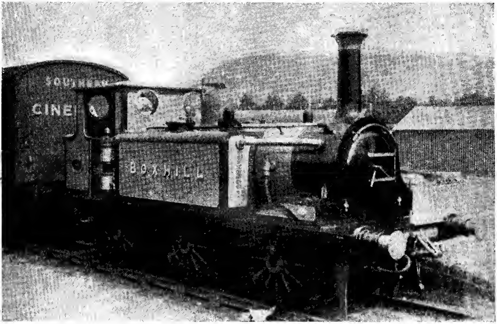
The model must be about 100 years old, for Mr. Newth was about my own age, and I'm no chicken, and assuming Mr. King's grandfather was contemporary with my own, he would have been in his prime in 1848, when that type of engine and boiler were in common use. The entirely undamaged condition of the model indicates that it must have been very carefully preserved for a very long time, and I am hoping that, when my days on this disturbed planet come to an end, it may be handed on to some model enthusiast who will continue to care for it as I have tried to do.

"BOXHILL"

by J. N. Maskelyne, A.I.Loco.E.

As one whose locomotive enthusiasm has developed from childhood memories of the old London, Brighton and South Coast Railway, I have been more than interested and delighted by an event which occurred during the year of grace, 1947. The Southern Railway, in its wisdom, had decided that one of those ever-renowned "Terriers" shall be preserved, her original condition, as far as possible, and painted in the once-familiar Stroudley livery.

I first heard of this project about twelve months ago, and, early last year, was informed of its due completion. At that time, I had no opportunity of inspecting the engine myself; and perhaps it is just as well, because I understand that some more or less minor errors were made in the



L.B. & S.C.R. No. 82, "Boxhill," restored to her original condition and old style of painting, at Dorking North, September 4th, 1947. The actual Box Hill is seen in the background

and the decision has been very satisfactorily carried into effect.

As most readers will know, the "Terriers" were a class of fifty small 0-6-0 tank engines designed by William Stroudley for the South London passenger services; it has now been definitely established from official records that the first engine of this class to be placed in service was No. 72, *Fenchurch*, which ran her first trip on September 7th, 1872. No. 71, *Wapping*, hitherto claimed as the first of the class, did not start work until the 12th of the same month; but the point is that September, 1947, marked the seventy-fifth anniversary of the introduction of one of the most fascinating, popular and successful passenger tank-engine designs ever placed upon a railway, and it is more than gratifying to know that their fame and glory is to be perpetuated in the best possible manner. For, not only is one of the engines to be preserved, but she has been fully restored to painting, and they rather shocked a number of stalwart Brighton enthusiasts!

However, such errors as there may have been were rectified before the little engine appeared in public. She is old No. 82, *Boxhill*, and seems to have been chosen because she was the only one of the survivors of her class on the Southern Railway to remain almost exactly in her original condition, except for the painting. From 1919 until August, 1946, *Boxhill*, minus name and number, and painted black for most of the period, was used as the works shunter at Brighton. I saw her many times during that long spell of duty, and noted spasmodic attempts to restore brightness to her copper chimney-cap. Her unattractive black coat, so *very* different from my early recollections of her, was for some time relieved, to some extent, by the legend "Locomotive Department" displayed in block letters on her side tanks. At a later date, this somewhat ambiguous title was changed into "Loco

Dept., Brighton Works," arranged in two lines. Later still, under Southern Railway administration, the number "380 S" appeared on the bunker sides.

I have to thank the Dorking Society of Model Engineers for my first and wholly unexpected sight of the post-restoration *Boxhill.* The society had invited me to undertake the judging of the models at its exhibition, and I arranged to do this on September 4th. On arriving at Dorking North station, and without any thought of *Boxhill* in my mind, I suddenly caught sight of her through a gap between a corrugated-iron shed and a coach standing in a siding. For the moment I could scarcely believe my eyes; but I remembered my pocket camera, which I now carry with me almost everywhere I go, and I decided that, before anything else was done, a photograph of the engine had got to be taken somehow. There was no possibility of getting at her from the platform, so I went out into the station approach to investigate. Here the problem was easy; in fact, it solved itself, for the yard where the engine stood was readily accessible.

Boxhill was not ideally placed for photography, but I made three exposures in rapid succession; the best of the results is reproduced herewith. The other two, while fairly good, are somewhat spoiled by obtrusive and unmanageable background objects.

Photography over, and with recollections of the reports of errors in the restoration, I carefully scrutinised *Boxhill* as she stood there, warm and sizzling slightly—for she was in steam. I could find little wrong with her, so beautifully has the restoration been done. The yellow colour, a little high in tone due to its newness, is correct and will probably become more subdued in time. The Westinghouse brake-pump is one of the modern ones, slightly larger than the original one; but I understand that not one of the original pumps is now available, so the one actually fitted is better than none at all.

To my mind, the only questionable detail is the shading of the letters of the name. This is done in the correct shade of blue-green to the left and black to the right; but the "picking-out" of the blue-green has been done in red, whereas my recollection is that this should be *white.* All the photographs of Stroudley engines that I am able to turn up seem to confirm my impression; but I would be interested to know what other Brighton enthusiasts have to say about this.

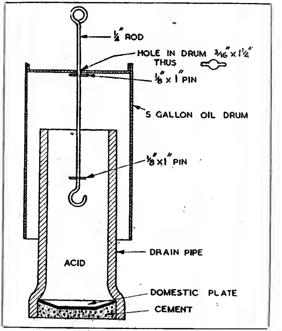
The old spotless cleanliness and polish are most excellently reproduced, and the modern generation may well stare in wonder at the sight of a *really* clean locomotive! In spite of the fact that *Boxhill,* under her own steam and hauling the Southern Railway's cinema-van, had arrived from Horsham less than an hour before, there was not a speck of dirt on her. She was certainly a sight to gladden the heart of anyone who can remember L.B. & S.C.R. locomotives as they were forty years and more ago; and surely she must be an inspiration to any locomotive enthusiast to whom the modern cult of filth and grime is so irritating.

A Clothing Coupon Saver

THE warning given by "L.B.S.C." in a recent issue of THE MODEL ENGINEER regarding the corrosive effect of pickling acid prompts this description of an effective and safe "Pickle Jar" for boilersmiths, which should save clothing and overalls being "peppered" with holes.

The acid container is a large drain pipe, into the larger end of which is placed an ordinary large china plate or dish and the remaining space filled with cement.

The cover is an old 5-gallon oil drum with the head removed and a slotted hole made in the bottom, as shown in the sectional sketch herewith. A ¼-in. iron rod is used on which to hang the hot boiler, two ⅛-in. holes being drilled in the rod at suitable distances and ⅛-in. pins driven in. A hook at the bottom end of the rod and a loop for hanging at the top end completes the apparatus.



The hot boiler is hung on the hook and the top pin allowed to go through the slot in the end of the drum. The boiler is then lowered into the acid—the oil drum covering the acid container before splashing takes place. The oil drum is easily replaced when corrosion has destroyed it.

—W. J. LEANEY.

Music and Mechanics

by

H. Staefel

(South Africa)

THROUGHOUT the many years that I have been a reader of THE MODEL ENGINEER the references to various musical instruments made by model engineers that have appeared from time to time have always held a special interest for me. The May 22nd, 1947, article on the Aeolian Harp by Messrs. H. P. and C. R. Ford is a case in point; but of more interest than the subject of this article was the opening sentence of the writers': "It is, perhaps, remarkable that musical instruments have always seemed to appeal to model engineers, but such is the case."

There was a time when I held the same opinion—but that was many years ago—for I had noticed a continual recurrence, too often repeated to be passed off as mere coincidence, of an interest in both music and mechanics in one and the same person. I may be pardoned for being the first case to come to my own notice and since I was at that time quite young it was then that I held those views expressed by the Messrs. Ford. As to which came to the fore first I am not able to say with certainty, if at all. It is true that I started to learn the violin at the age of 10; but I was pottering about with Meccano and mending broken toys years before that. Yet even then I seem to remember that I was fond of music and always singing, and my large stock of the old music hall ballads upon which I sometimes draw was laid in my very early childhood.

Came my apprenticeship days and I was to observe many mechanics and engineers who were executant musicians and later on, in my leisure hours, I came across many musicians whose own leisure was devoted to things mechanical of one sort or another—engine building, clock making, building radios, making recording apparatus for their own and their friends' benefit, and finally, the most logical aim of such pursuits, repairing their own musical instruments.

Now here, surely, we have a clue as to the association of music and mechanics. *A musical instrument is a machine*; a machine of a special kind it is true, but I recall the technical definition which states that "a machine is any device of two or more moving parts by means of which work is done" and a moment's thought will reveal that even the simplest of musical instruments, whether string and bow, or pipe with holes bored in, will fit in with such a definition. When the elaborate system of levers of the piano action is brought to mind, or the modern organ with its electro-pneumatic control is considered, one is straightway impressed with the importance of the engineer in the field of music. In fact, the more one delves into the history of music the more one comes to realise that the development of music has always—with very few exceptions—been dependent upon the mechanical arts. Put in another way this means that, but for the ingenuity of certain musicians and the musical bias of certain mechanics and engineers, music today would be little further advanced than any elementary vocal music; for it must be borne in mind that at one time simple instrumental music followed and actually took over the vocal line and also the vocal music has in its turn been influenced by the developing instrumental technique, as instanced in some modern compositions where singers are not required to sing any words but only vowel sounds as the composers desire to use the voice as part of their orchestral equipment—as just another instrument.

It is a most fascinating study, to follow the history of music and to note how, time and time again, a mechanical invention has caused the art to take further bounds forward. Among such may be mentioned the movable bridge of the monochord, the keyboard, the slidable nut of the violin bow, the hammer action and the escapement action of the pianoforte, the improvements to the flute by Boehm (himself a skilled craftsman and an outstanding flute virtuoso of his day) to mention only a few, but detailed study of any one is not possible in the present article, the chief purpose of which is to point out that, far from being remarkable, it is in the very nature of things that there should be a relationship between music and mechanics.

A few names might be mentioned of people who have achieved eminence in both arts. The first to come to mind is Sir George Grove, who was not only an outstanding figure in the world of civil engineering during the 19th century (he served under Robert Stephenson during the erection of the Britannia tubular bridge of the Menai Straits), but was a considerable force in the realm of music, becoming the

first director of the Royal College of Music. Grove, it must be admitted, did not interest himself in the mechanics of music, but his analytical notes of the works of famous musicians and his researches into their music serve to stress an aspect of music that, to the historian, is no less important than that with which this article is mainly concerned. He is best remembered by his monumental *Grove's Dictionary of Music and Musicians*, without which no music-lover's library is complete.

A Glass Harmonica

A name well known to MODEL ENGINEER readers is that of Benjamin Franklin, the American philosopher, statesman, man of letters and inventor. He constructed a "glass harmonica" using some 30 or 40 glass bowls of decreasing size, each pierced with a hole in the middle, and strung on a horizontal spindle as close together as possible without touching. He arranged that the spindle should be rotated by means of a pedal and the player touched the rotating rims with his fingers and thus successions of chords could be produced. The instrument had sufficient attraction for Mozart and Beethoven to induce these composers to write for it. Unfortunately, the peculiar irritation set up in the fingers of the performers caused serious nervous disorders and artists upon the "musical glasses" soon retired from their profession. It would be interesting here to quote Benjamin Franklin's account of his father —"He was ingenious, could draw prettily, was skilled a little in music and had a clear pleasing voice—played psalm tunes on his violin. He had a mechanical genius, too, and, on occasion, was very handy in the use of other tradesmen's tools."

The association of the late Sir Henry Wood with a tradition of mechanics has been referred to in past issues of this journal; and is it not significant that one of the best brass bands in England (which is to say "the world") is that of Foden's Motor Works?

Theobald Boehm, who lived during the nineteenth century was, as he himself has written, "a proficient goldsmith and was also skilled in the mechanic arts." While still a youth he learnt to play the flute. Being dissatisfied with the faulty intonation and awkward fingering of this instrument as it then existed he set about improving it in a very sensible fashion. He studied acoustics at a university for two years and with the scientific knowledge he then had he began at the beginning, literally, by working on a plain flute tube without any holes. He drilled the finger holes in the acoustically correct positions and, having many more holes than fingers, he set about devising a key mechanism that would enable him to play the most difficult passages of flute music with ease. The success he achieved can be judged by the fact that he became one of the greatest players of his day and he made many notable concert tours. His system of fingering became widely adopted not only for the flute, but for certain other wind instruments as well. Up to the introduction of the Boehm system, composers writing for the flute were constrained to write within the limits set by the imperfect instrument, but now they were free to extend its scope and write for a more fluid technique.

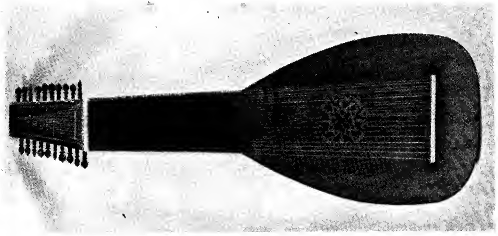
A study of the development of the trumpet reveals that most of the improvements have been introduced by either players or instrument makers. The forerunner of this member of the brass family was, clearly, the horn of an animal which had been hollowed out and pierced at the end. With the advent of the Bronze Age this natural horn would be copied in metal. The notes produced on such an instrument would be the plain harmonic series such as is produced by a bugle or hunting horn. It was found that finger holes drilled in the tube would enable higher notes to be produced and where a hole was left uncovered the same series of harmonic notes, but all in higher pitch, could be produced. The keyed bugle made its appearance having up to six or eight keys similar in action to the keys on the wood-wind instruments. Then came the introduction of valves, both rotary and piston, for the purpose of selecting different lengths of tubing. The modern trumpet manages with three valves only for its complete range of notes. If one realises that each successive step as outlined above gave the player a greater range of notes, and if one realises that composers were quick to seize upon the new and larger regions open to them for self-expression one can readily understand how entirely dependent upon the mechanic has been the musician and thus the mechanic has actually fashioned the way in which the art of music has been enabled to progress.

"Vertical" Music

Much the same story can be told in the history of pianoforte music, as the following will show. The later piano works of Beethoven are generally acknowledged to be amongst the richest in the whole literature of music written for this now ubiquitous instrument. When these later works are compared with his earlier works the most obvious thing to be noticed is the fact that rich and ponderous chords are continually occurring in the later compositions; so much so that the general treatment of such music could be described as "vertical." By contrast the earlier works have a distinct "horizontal" treatment; which is to say that right and left hands are travelling and playing melodies—lines of tunes—and in listening one gets the sensations of a moving along, almost a restlessness. Now two such distinct styles found in one and the same person but at two different periods of time illustrate my argument admirably. It is known that Beethoven learnt much of his composition from Haydn and he was influenced also by Mozart. These two composers wrote music for the keyboard when the harpsichord was at its greatest peak of development and the piano was just beginning to make its voice heard in serious quarters since, during the last quarter of the eighteenth century, the escapement action had been developed. It was not possible to get any heavy or continuous tone out of the harpsichord and in order that interest should be maintained for the listener, composers writing for this instrument would set down flowing lines

of melodies that tinkled, scintillated and rippled along; and much of the keyboard music of Mozart and Haydn is of this style. When the piano first came into use music written for the harpsichord would be played on it since it had the same keyboard; so that all the above considerations make it clear why Beethoven's early style followed these two masters. As Beethoven emancipated himself and developed his own individuality more he would delve deeper into the possibilities of the piano with its now almost perfected mechanism, and his rich chordal (vertical) treatment of his later compositions fully show what he was enabled to do, thanks to veloped; and when we find the fingers following the dictates of the untrammelled mind to such an extent that they neither obtrude nor interfere then we know that we have that entity known as the artist, whether his "machine" produces solids or sounds.

I will conclude by justifying my incursion into the pages of THE MODEL ENGINEER and show one of my efforts at musical instrument making. The photographs show a lute as used in the sixteenth and seventeenth centuries. It is not a copy of a particular instrument, but is a free-lance miniature of a typical instrument of that period. It has 20 strings—eight bass and



A free-lance model of a lute, a typical example of the sixteenth century

the ingenuity of musicians and the musical bias of mechanics.

I could continue thus quoting scores of examples that continually occur in music's long and interesting history, and if you accept my word that these improvements have been many and that they have, in every case, been followed by composers taking advantage of these improvements then I think you will agree that "it is *not* so very remarkable that musical instruments appeal to model engineers," because the very existence of music as we know it to-day has been dependent almost entirely upon the interest that mechanical genius has taken in musical instruments and their problems.

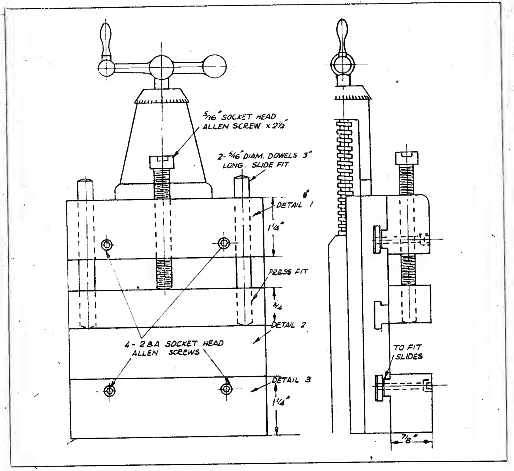
Now I go even further and say that there is a strong similarity between the mechanic and the musical executant. A mechanic is able to manipulate a machine and many of them can turn out works of art on these machines, to so high a pitch has their craftsmanship reached. Since we may describe a musical instrument say, a piano, as a machine, then a pianist must surely be a type of mechanic since he is manipulating a machine; and when his craftsmanship has reached an extremely advanced stage he then enters the region of the artist. Perhaps the whole question can be summed up as "manipulative ability" to an extreme degree which both mechanic and musician possess and have de-

six pairs of unisons, the first bass string after the unisons is dyed red to assist the player. The instrument is made to a scale of 1/5th, and is absolutely correct both historically and structurally, in every detail. The staves of the body are of maple with an inlay between each; the table (front plate) is of cypress, fingerboard, pegbox and string-bar are ebony, the pegs are rosewood and the nut at the top end of the fingerboard is ivory. The strings are of gut and the instrument will tune up—since the strings are calibrated carefully—and give the correct plucked-string quality. The frets, too, are of gut and are placed at the correct intervals down the fingerboard. Note the additional inlaid frets of ebony in order to extend the range beyond the limits imposed by the neck. The rose—the pierced circle—was a feature of the instrument and the maker would take great pains in carving this item; it was usually let in after being carved out of a hardwood or ivory or even copper. The varnish I made up myself and is of a rich and warm dark red, and I put on no less than 12 coats (four lots of three each and then well pumiced down) before I was satisfied. The grain can be clearly seen, however.

This example is one of a series I have made. I am hoping eventually to have a complete range,

(*Continued on next page*)

A Vice for the Vertical Milling Attachment



THIS short description and drawings of a vice I made for my vertical milling attachment might be of interest to readers, as it has the advantage of clamping-up square, does not stand out far beyond the faceplate, does not damage the faceplate in any way, can very easily be slipped on or off, or into the other groove for very thin work, and is very simple to make.

Details 1 and 3 can be made in one piece and cut in half afterwards.

I don't think I need explain in detail, as the drawing is quite clear.

—C. HUTCHINSON.

Music and Mechanics

(*Continued from previous page*)

all to the same scale, and all correct and practical, and which will serve to illustrate the history of a branch of musical instruments from the earliest time to the present day. It is a long job, and life is short.

Some may be puzzled at the choice of scale. Its origin was quite fortuitous and is really another story; but in actual practice I find it is just right, for the instruments are small enough to be attractive and intriguing and yet large enough to be quite practical, which I feel might not be the case if they were smaller. Here are the dimensions:

Length of body and neck ..	5⅝ in.
Width ,, ,, ...	2⅜ in.
Depth ,, ,, (front to back) ..	1⅛ in.
Length of Pegbox	2 5/16 in.
Weight	1 oz.

Towards the Model Gas Turbine

by D. H. Chaddock

THE articles by L.K.B. and Mr. Poole on their ideas for a successful model gas turbine are full of interest, as are the shrewd criticisms by Messrs. Umney and McLeod.

Personally, I am convinced that it can and will be done, but when and how is another matter. The "can't be done" critics I would refer to past volumes of THE MODEL ENGINEER in which small coal-fired locomotive boilers, passenger-hauling, small petrol and compression-ignition engines were all "proved" to be impossible and then sooner or later made.

The crux of the matter is the sooner or later business. In all fairness to the critics, they *were* impossible at one time and there were many early failures to support the view. But progress, generally by a few gifted amateurs, showed what had to be done and what must not be done and it is now possible for any moderately careful model engineer to enter these fields with every chance of success at the first attempt.

If history is not, as Henry Ford said, "all bunk," what then are the possibilities of the model gas turbine and where are the red lights. Have we, as modellers, anything in our favour? I think we have because, since nature won't be scaled, for an equal degree of efficiency our model will be more powerful for its size than the prototype, just as model locomotives shift greater proportionate weights and petrol engines develop more power per litre. Suppose we could make and run an exact 1/20th scale "Goblin" and all the efficiencies were precisely the same as the full-size article, then its performance, based on published information, would be :—

Compressor, rotor diam. and tip width, $1\frac{9}{16}$ in. × 7/64 in.
Turbine, wheel diam. and blade depth, $1\frac{3}{8}$ in. × $\frac{3}{16}$ in.
Speed, starting to full load, 30,000 to 204,000 r.p.m.
Turbine and Compressor horse power, 14.3 h.p.
Air flow, full load, 0.15 lb./sec.
Fuel consumption, full load, 1 gal./hr.
Static thrust, $7\frac{1}{2}$ lb.

It certainly sounds an incredible performance from such a minute piece of machinery, but is it possible? I believe it is. Firstly, Mr. Walter Elkin has spun a turbine rotor of about this size at 106,800 r.p.m. with only a wee jet of steam from a single Laval nozzle 0.022 in. diameter. The gas turbine has full annular admission and the mass flow is 144 times larger. It will spin all right if it can once be got up to and beyond the critical and starting speeds.

The compressor side is more difficult. Mr. McLeod very rightly points out that one half of the energy conversion takes place in the diffuser. To make a reasonably efficient rotor should not be too difficult. Built up brass blades sweated together are certainly out, but a tolerable rotor shape can be hacked from solid duralumin which approximates to the intricate contours of the original. I have studied diffuser shapes very carefully from the earliest Whittle designs to the latest and it seems that simplicity is the keynote to efficiency. The latest Rolls Royce "Nene" engine for example seems to have almost straight, tangential, slightly divergent diffuser passages followed by an abrupt right-angle bend with guide vanes. Nothing here which a careful model engineer cannot copy and polish until it has a surface like glass, so that I should like to ask Messrs. Umney and McLeod to come into the open and to design a diffuser which is efficient and which can be made by the means at the disposal of an amateur.

Combustion is, in my opinion, the *pons asinorium*. We have got to burn as much fuel as a five-pint blowlamp going all out, keep it alight in a howling gale of compressed air, and get it all over in a can no bigger than an ordinary flame tube. Combustion outside the flame tube merely overheats the turbine wheel and adds nothing to the useful power. This is where the bit about scaling nature kicks us in the pants, because it seems that you cannot scale the size of a flame. But perhaps some "L.B.S.C." of the future will discover the right proportions for this all-important part and we shall burn our fuel as easily and efficiently as any "live steamer."

Mr. Poole's ideas seem to be shaping along rather different lines. He is going to compress air in two stages in Rootes-type blowers and expand it after combustion in a piston engine. Has this any claim to call itself a gas turbine? It would seem to be more like the old Buckett hot-air engine brought up to date with a rotary compressor and liquid fuel firing, but still retaining all the difficulties of a piston and valve mechanism which must work at cherry-red heat.

I was very surprised to see the high efficiency figures he quotes for small Rootes-type blowers. Do they relate to volumetric or overall adiabatic efficiency? It is the latter that counts in a gas turbine. My model "Zöller" supercharger although made with the utmost care did not do better than 60 per cent. adiabatic efficiency. With this I was well pleased, since I understood that the smallest full-size machines did not do better than about 60 per cent. The volumetric efficiency was, of course, much higher.

Mr. Poole is going to use a regenerator to improve, as he says, the efficiency. By saving some of the heat which would otherwise have to be obtained from the fuel it will improve the thermal efficiency. But it will also introduce a pressure loss on both the intake and discharge sides of the turbine and Mr. McLeod has already shown how very critical is the margin between power available and power required for the machine

(Continued on page 100)

*A One Minute Transformation

A Cabinet Workshop with a Difference

by C. R. Jones

THE doors are hinged at the left side to the end panel, and the hinges are so fixed that the doors fold round flush with the left side of cabinet out of the way when the lathe is in use.

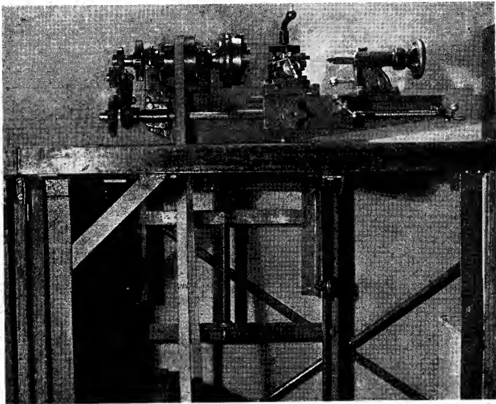
They are held in the shut position by a bolt at the top.

At this point the whole of the woodwork, now finished, was given a coat of dark oak stain, and except for the opening to eventually receive the chest of drawers, looked quite tidy.

which were thought at first to be just the thing, and were then discarded for some reason or other.

The problem was put aside for some days, and then inspiration came through seeing a garage crane with a beam which lifted up parallel with the ground, the end of which was mounted on a sort of carriage which had flanged wheels that ran up or down the main support, being operated by means of a steel cable.

The present arrangement was designed on



View showing the lathe in the up position

It was decided to leave the drawers till later, mainly because the necessary material was lacking, and to get on with the lathe-lifting apparatus.

This proved quite a problem, as the lathe weighs something like 70 lb., and innumerable sketches were made of various arrangements,

these lines, but using the screw and nut of a car-bumper jack, to raise or lower the lathe. The carriage or bracket is shown in the photograph in an inverted position for convenience of photographing, together with the screw and nut. It was welded up from $1\frac{1}{2}$-in. × 3/16-in. angle-iron (not the bedstead this time).

Two flanged wheels $1\frac{3}{8}$ in. diameter on the treads were turned up, and two bronze pulleys which had deep grooves were found in the

*Continued from page 58, "M.E.," January 15, 1948.

scrap box. These were mounted on the carriage, in the positions shown, by means of high-tensile bolts and stationary steel bushes.

Two vertical rails made of $1\frac{1}{2}$-in. × $\frac{1}{4}$-in. angle-iron were fitted at the rear of the structure, by means of suitable brackets and high-tensile bolts. These were for the carriage to run up and down on, and it will be seen that the flanged wheels run on the flat of the rails at the rear, and the grooved wheels on the front edge.

The jack-screw was cut off to length and turned down to $\frac{5}{8}$ in. diameter at the top end, and at the lower end to fit a thrust-race which was originally made for a car steering.

The bench was drilled at the top in the appropriate position, and a flanged bush was made up, the flanged portion of which was sunk flush with the top of the bench and held in position with wood screws.

The lower end of screw and thrust-race was supported by a bracket bolted to a cross-piece made from 1-in. "U" section-steel, the ends of which were bolted to the rear sides of the upright rails.

A handle was made up to clamp on to top of screw and can be taken on or off by means of one or two turns of the nut.

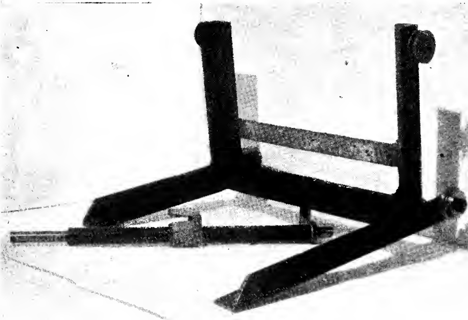
The nut belonging to the bumper jack had a tapered slot in the top side, and this just fitted on the angle-iron cross-piece of the carriage, the weight of the lathe keeping it in place.

The angle-iron rails were fitted so as to bring the top of the lathe carriage level with the underside of the bench, when in the up position, and the ends of the left-hand top cross-piece of the carriage overlap the opening in top of bench by about $1\frac{1}{2}$ in., but more about this later.

Having got the carriage to rise and fall satisfactorily by means of the screw and handle, a shelf or bench to mount the lathe on was made up from good solid 1-in. material, with cross-pieces of the same stuff, glued and screwed on in the vital positions.

This was made a good, but not too tight, fit in the opening in bench top, and with the carriage in the up position, was put in place on it, and the holes which had been previously drilled in the top of carriage, carefully marked off, and drilled, and the carriage bolted to shelf by means of $\frac{1}{4}$-in. coach bolts and nuts.

The lathe was now put in place, and the holes marked off on the shelf for the belt to come up through, these were then cut out and the top of shelf was covered with stout sheet-metal, screwed on.



An inverted view of the lathe carriage, and the operating screw and nut

The fixing of the lathe was the next job, and after this had been done, a trial was made and all seemed satisfactory, and the correct position being found for the foot-motor, this was fixed in position by means of a couple of brackets.

It will be noticed that the carriage is not in the centre of the lathe, but takes the weight more or less centrally at the lathe's bolting-down point, so, at the right-hand side of the shelf, a cross-piece of $1\frac{1}{4}$-in. × $\frac{1}{4}$-in. flat-iron was screwed on the underside, across the shelf, and this piece also overhangs the bench opening for $1\frac{1}{2}$ in. at the front and rear.

The object of the overhang at these four points (two points mentioned previously at left of carriage), was that it was intended to drill the bench at the places these ends contacted, when

the carriage was up, and to have four set-screws with a coarse thread to hold carriage and lathe firmly in position while being used.

Here, it must be confessed, a snag arose, as it was found that the steps on the foot-motor flywheel did not match those on the head-stock pulley, and so far the lathe has been used without any extra fixing, as it is possible to tighten the belt by raising or lowering the lathe about ½ in. or so.

It is hoped as soon as it can be managed, to make another pulley for the lathe headstock, with different sized steps, which it is hoped will match those on the foot-motor; when some positive locking device will be fitted.

The lathe has been used quite a lot since the cabinet was made, and everything has gone well, though no very heavy jobs have so far been attempted.

Having got the lathe fixed and working satisfactorily, and having in the meantime collected some wood, the chest-of-drawers for tool storage was made. It is not proposed to go into detail about this, except to say that it was made as one unit, and this simply slips into the opening left for it, and is secured in position with metal thread-screws and nuts.

It should be mentioned that the reason the top two drawers are narrower than the other four, is because the lathe and shelf, owing to their length go beyond the extra bench leg mentioned previously, so these drawers had to be kept to the right to allow the lathe room to travel up or down.

The drawer unit was stained to match the rest of the cabinet.

One other thing done was to sink a 5/16-in. thick steel plate in front left-hand corner of the bench top, and this had three tapped holes in it to enable a 2½-in. parallel vice to be easily screwed on or removed. This vice can be seen in the photo on page 57 of last week's issue.

Above the bench a gas point has been fixed to enable a bunsen burner, blowpipe, etc., to be used.

It is hoped that the text and photographs have combined to give any reader the necessary information should they contemplate making a similar cabinet workshop, and owing to the difficulty of getting suitable materials, it was thought unnecessary to go into too much detail, as in all probability the design would have to be altered considerably to suit whatever materials were available, and although welding has been extensively used in the case described, there is no reason why the whole thing could not have been bolted together.

Referring to the title of this article, the top lid or cover can be removed, the doors opened and folded back, and the lathe wound up into the working position, including putting on the belt, within one minute.

The amount of rise and fall of the lathe and carriage is one foot, and the original handle for operating it is still used, though it was intended to make a handle to fit a square filed on the lifting screw; in fact, the handle is seldom taken off, as a photograph or some other camouflage effectively hides it.

One point that could be improved, is that the lathe opening in the bench top is central, and as this opening is 12 in. wide and the total width of the bench is 22 in., that makes 5 in. width of bench at front and rear. The amount at the rear being so narrow leaves very little room to operate the handle, and it would be an improvement if either the total width of bench was increased or the width of bench at rear of opening was increased.

Towards the Model Gas Turbine

(*Continued from page* 97)

to be even self-driving. The same goes, in even stronger measure, for the proposed step-up gearing between engine and compressor.

To sum up then, what are the conditions that it would appear necessary to fulfil for success?

(1) *Simplicity.* Not in the words of a famous catalogue "a single oscillating cylinder for simplicity" but the highly refined external simplicity of a Spitfire compared with an early Wright biplane. The gas turbine is essentially an aero-dynamic machine and its internals must be "clean."

(2) *High Speed.* Whether we like it or not we have got to break into the realms of hundreds of thousands of revolutions per minute. There will be no difficulty here if a due sense of proportion is retained and the design is mechanically and aerodynamically clean. But it is a matter of watchmaking and not tin fans fastened on to a spindle with a boss and set-screw. The smaller and lighter all the moving parts are, the easier they will be to balance and the less the ill effect of such unbalance as must remain.

(3) *Shape.* An aeroplane flies because of the shape of its parts. If the shapes are wrong, or wrongly related to one another it does not fly or is uncontrollable. A gas turbine depends on its shape, the shape of the compressor rotor, of the diffuser, of the turbine wheel blades and guide blades and, to a large extent, on the shape of its combustion chambers for its success. These shapes have been studied and certain rules deduced. This is theory. One could ignore all theory and try all possible shapes and combinations of shapes, but one lifetime would not be long enough. Theory will tell us as far as it can, what shapes are good and what are to be avoided, and so cut down the amount of practical experimental work to the exploration of profitable avenues.

Our Anniversary Post Bag

F. C. R. Douton writes :—

"FIFTY, NOT OUT—— Well played Sir! Sincere congratulations to THE MODEL ENGINEER on the attainment of its JUBILEE! I first became acquainted with THE MODEL ENGINEER shortly after the beginning of my apprenticeship (1903-1908), and I want you to know that I am deeply grateful to you and to your many contributors for an enormous amount of valuable information, advice and instruction. This applies not only in connection with model engineering, but also with a wonderful variety of other interesting subjects.

"There is, and always has been, a friendly, personal atmosphere about THE MODEL ENGINEER, which, though difficult to describe, makes it very attractive. Best wishes for the next 50 years."

John W. Smith (Glasgow S.M.E.) writes :—

"Please accept, on behalf of Mr. P. Marshall, and staff of THE MODEL ENGINEER, the greetings and seasonal good wishes of the president, officers and council of the Glasgow Society of Model Engineers. Despite these times, they wish your work success in the year of grace nineteen hundred and forty-eight."

Edward Bowness writes :—

"On this 50th Anniversary of THE MODEL ENGINEER, I feel I must let you know something of what THE MODEL ENGINEER has meant to me in life, an experience which doubtless has been repeated in thousands of instances unknown to you. I cannot remember how it happened, but although I lived in a small country town in Cumberland, I saw a copy of No. 1 of THE MODEL ENGINEER. It was just what I had been looking for. I had made a few crude model yachts and had just completed a small cardboard model of one of the famous Midland 7 ft. 6in. 4-2-2's. I entered this in the competition announced in No. 1, and to my surprise and delight secured a place amongst the first six. That same year I left home to serve my apprenticeship in engineering in Lancashire, and as I was in 'digs' and had no workshop, and no time owing to evening classes I stopped getting THE MODEL ENGINEER after the first two volumes—an action I have often regretted since. But I saw it frequently and THE MODEL ENGINEER has always been a part of my life. I think I have seen every Model Engineer Exhibition. You gave me a very kind reception when I called on you at THE MODEL ENGINEER offices about 1930, and as a result I commenced to contribute to *Ships and Ship Models*, and later to THE MODEL ENGINEER. I count myself honoured to have been allowed to join your staff a year ago and to work in the friendly atmosphere which permeates the staff you have gathered around you. May you be spared to us for many years to come."

B. A. Stenning & Sons write :—

"Congratulations to you on reaching the jubilee year of THE MODEL ENGINEER; a publication which has given myself and thousands of others so much pleasure and useful information. It was first introduced to me by the engineer of the silk factory at Malmesbury, Wiltshire, in 1898. I think it was in August, 1898, that you gave instructions on making and winding a two-pole dynamo, which I made up successfully at the age of 17. I have two married sons who are also ardent model engineers and we pass our weekly copy to each other. May you enjoy many more years of good health and prosperity is the wish of 'we three'."

T. W. Pinnock (S.M. and E.E.) writes :—

"I should like for myself and on behalf of the S.M.E.E. Affiliation, to congratulate most heartily THE MODEL ENGINEER on its fifty years of achievement and to wish it the best of luck in the next fifty years. I am one of those who have taken up model engineering in the days when it was already fully established, and I have not had to share the difficulties and the disappointments of the pioneers. but I for one certainly do appreciate how much we owe, often without realising it, to those pioneers of the early days who, under your leadership, made the model engineer and the model engineering movement what it is today."

Mr. F. W. Bontor writes :—

"I envy you the fact that you can look back through fifty years of editorship of the paper that has virtually brought together model engineers the world over—to become such a happy brotherhood of men and women. I would like to take this opportunity of conveying the best and kindest wishes of all the Malden Society's members, coupled with my own. May we all enjoy your 'Smoke Ring's' for many years to come."

Miss Marion Hellewell (Director, Moore & Wright) (Sheffield) Ltd. writes :—

"Hearty congratulations on the 50th Anniversary of THE MODEL ENGINEER. I think it is a proud record, and I should like to say how much we have always enjoyed our association with all your staff."

Buck & Ryan Ltd. write :—

"We would like to congratulate you on reaching the 50th Anniversary of the publication of THE MODEL ENGINEER, and to wish you continued success in the future. May we take this opportunity of sending greetings to all the good friends and pleasant contacts we have made through this medium during the past thirty to forty years, and hope the same good relationship will be standing when you celebrate your Centenary."

K. N. Harris writes :—

"Just a few lines to congratulate you upon the Golden Jubilee of THE MODEL ENGINEER. I am sure it must be a source of great satisfaction to you personally to have founded this journal, and still to be actively connected with it, fifty years later; it is an achievement of which you may be justly proud. I have been a reader since the first issue (I was 11 at the time), and I have a complete set from the start: they are a source of never-ending pleasure to me, somewhat nostalgic these days, for of the fine old brigade, only yourself, Jim Crebbin and Bradbury Winter remain."

Editor's Correspondence

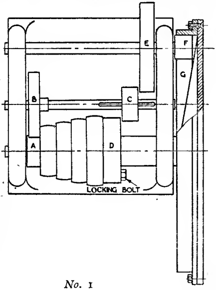
Triple-Geared Lathes

DEAR SIR,—With reference to the letter from Mr. James Anderton, of Nelson, in THE MODEL ENGINEER of November 13th last, in which he asks for information concerning the triple-back-geared lathes of fifty years (and more) ago, the sketches reproduced herewith may be of interest to him.

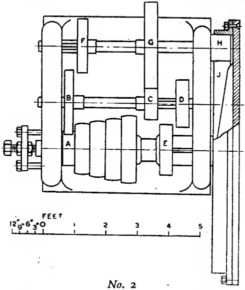
Having worked on these lathes myself, but not fifty years ago, only twenty-five, the main essentials of them come readily to my mind, but, alas! the details have become hazy in my recollection. I can well remember, however, that the final train of the triple-gear was formed in the face-plate itself, which was of large diameter and carried a gear-ring, with internally-cut teeth, and bolted to the periphery of the face-plate, or, as it usually was, the chuck-plate; this gear-ring meshed with a spur pinion carried on the end of to slide along a feather sunk in the second shaft. The cone-pulley locking-pin, or nut and bolt as it was in those days, had to be disconnected when using the double, or the triple-back-gear.

The other details of this type of gear are not quite as clear to me as they should be, but I seem to remember that it was also possible to slide the pinion (F) out of mesh with the gear-ring (G) to be able to use the cone-pulley driving the mandrel directly.

The other type of triple-back-gear which is represented by sketch No. 2 was also familiar to me; but, in this case, my memory has received a lot of assistance, for, fortunately, I possess an excellent drawing of this identical triple-gear applied to a large boring-mill, made, I believe, by Messrs. John Hetherington, of Manchester, who specialised in the manufacture of extra-large machine tools sixty or seventy years ago.



No. 1



No. 2

a shaft placed behind the usual second shaft of the back-gear. We will call this shaft the "third" shaft, merely to avoid confusion. In some cases, this third shaft was itself driven by a spur gear, marked E in sketch No. 1, which could be put into mesh with the second pinion (C) of the normal back-gear train, the pinion (C) being able

Curiously enough, the shop where I had the good fortune to serve my apprenticeship, Messrs. David Rollo & Sons, of Liverpool, had one of these very boring-mills of exactly the same size as the scale shows, and also several other large lathes made by the same firm of Hetherington, as well as large slotting-machines and planing-

machines. The most curious thing, however, is the fact that I purchased the book containing the drawing (called *The Engineer and Machinist's Assistant*, published by Blackie & Son, *circa* 1850) whilst still serving my time, and it remained in my possession a great many years before I realised that this drawing was of the same machine which I had been acquainted with so long ago.

The aforesaid book is very valuable to me now, for it contains, among many other interesting and historical drawings, detailed drawings of side-lever and also direct-action paddle engines as used by the navy in those far-off days.

To return to the triple-geared lathes, I am fairly certain that we had one made by the famous firm of Joseph Whitworth, but cannot remember the details of the gear change. As far as I can remember however, the practice of using the internally-cut, or cast, gear was invariable on these large lathes; modern design may have originated other methods, as, for example, precision-cut worm-gears. The gear shown in sketch No. 2, which I have copied exactly from the drawing (that is, with regard to sizes, for I could never hope to attain the excellence of the original—they were draughtsmen in those days!) is rather more elaborate than in sketch No. 1 and does not permit of direct drive to the mandrel, though this would be fairly easy to achieve if required.

As shown, the pinion (H) is always in mesh with the gear-ring (J); the cone-pulley has no locking-bolt and so runs freely on the mandrel, carrying with it the pinion (A) which drives the spur gear (B); this, in turn, drives any one of the three gears (C), (D), or (F), but only one of them at a time. It is easily seen that (F) cannot be meshed with (B) while (C) is in mesh with (G), as (G) is a fixture on the third shaft, so that when (F) and (B) are meshing, (C) and (G) must be put out of mesh, as also must (D) and (E).

I can well remember how wary the old turners used to be of this chance of a smash-up, particularly when we apprentices were "assisting" them. The fastest speeds were given by meshing (D) with (E), and making sure that (F) and (C) were clear of their respective partners, the third shaft was then rotated idly by the ring-gear and used to make a dickens of a row, as it was revolving at a comparatively high speed.

The three gear ratios of mandrel to faceplate would be approximately two to one, twelve to one, and forty to one with four belt changes for each of these, so this gave quite a respectable range of speeds, as Mr. Anderton evidently requires.

Note the old-fashioned thrust at the end of the mandrel—just a needle-pointed set-screw bearing against a dimple in the centre of the mandrel—quite a common thing not so long ago. There was another form of gear-box, of which I read some years ago, consisting of all-chain drives, but am not sure whether it was applied to lathes or motor-cars. It was called the Sperber gear-box, I believe, and the chains used were of the silent, inverted tooth type.

Hoping that the above particulars will be of some interest to Mr. Anderton and others.

Yours faithfully,

Liverpool. WM. CLEGHORN.

B.A.G.S.R. Locos

DEAR SIR,—I wonder if some other reader could supply me with some information, or put me in touch with someone who could give details and types of the locomotives used on the Buenos Aires Great Southern Railway from when it was started (about 1865) to the early 1900's. I am interested in the railway, as my father worked on it for many years, and I know the locos of the period 1906-1924.

Yours faithfully,

Stoke-on-Trent. R. W. REYNOLDS.

Valve-Gear Locking Devices

DEAR SIR,—With reference to the question of valve-gear locking devices, I most definitely agree that they are fitted, although I doubt if a gear as arranged like R. H. Evans's model would require such an elaborate method. However, marine engineering practice is a very awkward subject on which to make any definite statement, as very few engines are absolutely alike and the methods of running them frequently differ from ship to ship, even in the same company.

Most of the ships in which I have served were fitted with reciprocating steam engines, and had Brown's steam hydraulic reversing equipment, the control handle of which had only three positions: "Ahead," "Mid-Gear" and "Astern," which meant that any adjustment to the power *had* to be made with the independent gear. At "Full Away," we normally worked up to the required speed, first on the throttle on wet steam, and then, having set the superheat temperature, set the independent gear to whatever figure the chief had decided was a good average figure to get us to our next port of call on time. This is a bit more awkward than winding the handwheels of an all-round gear I agree; but it has always been my experience, though, as I have said, practice varies so much.

Yours faithfully,

Maidenhead. D. G. WEBSTER.

Lathe Headstock Bearings

DEAR SIR,—The letter on the above subject on page 593, was of great interest to me, as my work these last few years has given me the opportunity of trying out a good number of lathes of different makes and sizes. I don't doubt that what Mr. E. H. Doughty says about mounting (Figs. 1, 2 and 3, on pages 593-4) being excellent on large and heavy machines, but the mounting, as in Fig. 4, on a lathe of the average sizes required by a model engineer ($3\frac{1}{2}$ in. to 6 in. centres), is nothing like as good as a plain bearing. I bought a new lathe some years ago; it was fitted with roller-bearings, as in Fig. 4, and I tried for years to make the thing give me a good finish on the work, and not chatter at the least provocation. But it would not do anything like as good as my smaller (and much cheaper) lathe with plain bearings. I have found by experience that a good plain bearing will "knock spots" off anything fitted with roller-bearings. I have tried a new lathe during the last twelve months, and I still find that the plain bearings give the better results.

Yours faithfully,

Chester. W. H. ELLIS.